TESIS

THE LACK OF DEMAND FOR EDUCATION

IN THE STATE OF NUEVO LEÓN:

WHY AREN’T MEXICAN YOUTH ATTENDING HIGH SCHOOL?

MAESTRÍA EN ECONOMÍA Y POLÍTICA PÚBLICA

POR:

ANDREA BEREZNAK

DICIEMBRE DEL 2007
Los miembros de este comité recomendamos que la presente tesis del Lic. ANDREA BEREZNAK, sea aceptada como requisito parcial para obtener el grado académico de Maestra en: ECONOMÍA Y POLÍTICA PÚBLICA

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COMO REQUISITO PARCIAL PARA OBTENER EL TÍTULO DE
MAESTRA EN ECONOMÍA Y POLÍTICA PÚBLICA

DICIEMBRE DEL 2007
Appreciation

To my parents, for your unconditional love and for supporting me in all of my pursuits.

To my advisor, Dr. Héctor Villarreal, for your guidance and willingness to work with me on this project.

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The Lack of Demand for Education in the State of Nuevo León: Why aren’t Mexican youth attending high school?

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ABSTRACT:
This study examines the lack of high school attendance for youth in the Mexican state of Nuevo León from both a theoretical and empirical perspective. Although the situation carries a great many subtleties, we find the reasons for lack of attendance to be principally economic. The combination of poor returns to high school education and available labour market opportunities for workers with a middle school education provides strong disincentives to continue education into high school. Public policy aimed at increasing educational attainment within the state must discover the causes behind the lower economic returns to high school qualifications and adapt programs accordingly if they are to seriously address the issue.
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I. INTRODUCTION

The role of education in the development process has become highly debated in recent decades. Much has been published confirming the importance of education in promoting economic growth in developing countries. Many studies find varying levels of returns to education for different countries and situations, but nearly always conclude that education is a key variable in the economic well-being of the populations analysed (see full discussion in Section III). The overall level of human capital in a country is one of the most significant factors enabling economic expansion and advancement (Lynn, 2003). While in highly industrialised countries virtually all children of primary and secondary school age are enrolled in educational institutions, this remains far from the reality in many developing countries (Lynn, 2003). Continued modernisation and globalisation offer new opportunities and incentives for individuals to acquire more human capital, and formal schooling generally serves as the most significant platform for this development (Parrado, 1998). School is considered to be a motor for economic growth and innovation, as well as purported to contain important equalising properties across populations in terms of employment opportunities and remuneration.

In our study, our objective is to understand the decision of Mexican youth to attend or not to attend high school in the northeastern state of Nuevo León. What are the characteristics of this age group and the reasons preventing half of this cohort from continuing their education beyond middle school? We witness an uncommon situation in the state of Nuevo León, as compared to the rest of Mexico. The state has nearly universal coverage of education for its populace. While youth who desire to study may face a host of other obstacles, in practically all cases there does exist a free public high school into which they could enter. Additionally, Nuevo León boasts a relatively ample supply of employment opportunities for workers with middle or high school qualifications. In Nuevo León, the issue of school attendance is truly one of individual choice. This allows us in our study to examine those factors that affect the participation decision with confidence that our results will be relatively straightforward.

In the following section we review the current situation of education in the northeast Mexican state of Nuevo León. The economic stage is set in section III with the presentation of the economic theory surrounding education consumption choices. A review of relevant parts of the literature on school enrolment is also presented. Section IV presents a theoretical behaviour model for school enrolment decisions. Section V explains the data to be utilized in this paper. The sixth section includes the empirical work of the study. Results of both regression model estimates are presented in this section. Section VII summarizes key findings and presents the calibrations of our theoretical model using our empirical regression results and. The final section (VIII) explores public policy implications.
II. BACKGROUND

Two of the commonly cited concerns regarding development in Mexico are high levels of income inequality and poverty. Raising education levels of lower socioeconomic groups has been promoted as one potential equalizing and poverty reducing force (López-Acevedo, 2001; de Hoyos, 2007). In this section, we provide a basic picture of the current inequality, poverty and education attainment in Mexico, so as to provide the reader with an understanding of the current situation.

Inequality in Mexico over the past decades has increased (confirmed by López-Acevedo, 2006, 2001; López-Acevedo, 2006: de Hoyos, 2007). Gini coefficients estimated for Mexico signal a slight rise in overall inequality from 0.425 in 1984 to 0.460 in 2004 (Székely, 2005). These figures are high compared to most developed European countries, but slightly below the average statistics within Latin America. In terms of poverty, incidence decreased dramatically between mid-century and the 1980s. Over the past two decades poverty rates have continued to drop at a slower pace. However, in 2004 still nearly one half of Mexicans were living below one of the three established poverty lines (see Figure 1).¹

Figure 1

<table>
<thead>
<tr>
<th>Year</th>
<th>Per cent below Poverty Line 1</th>
<th>Per cent below Poverty Line 2</th>
<th>Per cent below Poverty Line 3</th>
<th>Gini Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>61.8</td>
<td>73.2</td>
<td>88.4</td>
<td>0.520</td>
</tr>
<tr>
<td>1956</td>
<td>64.3</td>
<td>69.8</td>
<td>83.5</td>
<td>0.520</td>
</tr>
<tr>
<td>1958</td>
<td>61.0</td>
<td>70.0</td>
<td>81.3</td>
<td>0.530</td>
</tr>
<tr>
<td>1963</td>
<td>45.6</td>
<td>55.9</td>
<td>75.2</td>
<td>0.570</td>
</tr>
<tr>
<td>1968</td>
<td>24.3</td>
<td>44.7</td>
<td>69.4</td>
<td>0.540</td>
</tr>
<tr>
<td>1977</td>
<td>25.0</td>
<td>33.0</td>
<td>63.8</td>
<td>0.490</td>
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<tr>
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<td>22.5</td>
<td>30.2</td>
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</tr>
<tr>
<td>1989</td>
<td>22.7</td>
<td>29.3</td>
<td>53.5</td>
<td>0.465</td>
</tr>
<tr>
<td>1992</td>
<td>22.5</td>
<td>28.0</td>
<td>52.6</td>
<td>0.475</td>
</tr>
<tr>
<td>1994</td>
<td>21.1</td>
<td>29.4</td>
<td>55.6</td>
<td>0.477</td>
</tr>
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<td>1996</td>
<td>37.1</td>
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<td>40.7</td>
<td>63.9</td>
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<tr>
<td>2000</td>
<td>24.2</td>
<td>31.9</td>
<td>53.7</td>
<td>0.481</td>
</tr>
<tr>
<td>2002</td>
<td>20.3</td>
<td>27.4</td>
<td>50.6</td>
<td>0.454</td>
</tr>
<tr>
<td>2004</td>
<td>17.3</td>
<td>24.6</td>
<td>47.0</td>
<td>0.460</td>
</tr>
</tbody>
</table>

¹The first poverty line in Mexico is defined by the income required to purchase a common basic food basket set by the Mexican National Evaluation Board for Social Development Policy. The income restriction for the second poverty line is determined by the quantity required to purchase the first consumption basket, plus basic education and health services. Poverty Line 3 includes income required by the first two lines, plus resources sufficient to provide for public transportation, basic clothing and housing.

²Source: Székely, 2005
In light of these poverty and inequality figures, we turn to potential causes and solutions. Education has been found to account for the largest share of income inequality in Mexico, up to 20 per cent during the 1990s (López-Acevedo, 2001; De Hoyos, 2007). Particularly for workers in lower socioeconomic brackets, labour remains the main asset for wealth and income accumulation, and education is the foremost indicator of future earnings. Thus, it is clear that schooling has the potential to play an important role in the well-being of both current and future generations of workers in Mexico.

It is of positive note that average educational attainment in the country has been rising over the past half century: López-Acevedo reports the change to be from 2.76 years in 1960 to 6.5 years in 1990 (2001). Average educational attainment for individuals over 16 years of age was 8.1 years in 2000 and 8.9 years in 2004. The average education level in the state of Nuevo León in these years was slightly higher than the national average at 8.3 years in 2000 and 9.6 years in 2004. According to Martínez, in 2000 the average educational attainment in the country was 7.5 years and in Nuevo León 8.9 years; these statistics further separate Nuevo León from the rest of Mexico (2002). According to Approximately 92 per cent of citizens in the country over the age of 15 are literate, and the average school enrolment rate in 2005 for children between 5 and 15 years old was 88 per cent (Censo de Población y Hogares, 2006a). In fact, between 1995 and 2002, school enrolment in primary, middle school and high schools in Mexico increased by 11 per cent (OECD Education, 2005). These are respectable figures, given that several other Latin American countries publish literacy rates in the 70 per cent range. Particularly in the state of Nuevo León, between 1970 and 2000 the average educational attainment grew by 4.08 years, although Martínez argues that this growth is due more to inertia than public policy specifically oriented toward improving educational attainment (2002). The state ranked second in average educational attainment across this 30 year span of time (Martínez, 2002).

Although Mexico cannot be classified among the most underdeveloped of nations in terms of its human capital base, the country still falls far behind developed countries in average educational attainment. Even in Nuevo León (one of the most developed states in the country), only 20.9 per cent of the population over the age of 15 had completed high school in 2000. Five years later, in 2005 the same statistic was 21.2 per cent for Nuevo León and 18.5 per cent in Mexico as a whole (Censo de Población y Hogares, 2006b).

Despite the direct implications of educational attainment on earnings, the average Mexican may barely complete middle school. In Mexico, we observe...

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3 Authors' calculations using data from the Mexican National Institute of Statistics, Geography and Information (INEGI for its Spanish Initials) National Household Income and Expenditure Survey (ENIGH).
4 Authors' calculations using data from the Mexican National Institute of Statistics, Geography and Information (INEGI for its Spanish Initials) National Household Income and Expenditure Survey (ENIGH).
spikes in attainment rates at the end of elementary and middle school education.\textsuperscript{5} In 2005, of all Mexican children of the appropriate ages, 93 per cent attended primary school and 86 per cent attended middle school. However, only 51 per cent of Mexican youth were attending high school. This means that only half of the current population of 15-19 year olds in Mexico could possibly obtain a high-school degree, if they manage to complete their studies (see high desertion rates in Figure 2). Statistics show that just above 50 per cent of students who begin high school will finish their studies and graduate. Currently, Mexico has the lowest rate of high school completion in the OECD among 25-34 year olds; only 25 per cent of Mexicans in this age group hold a high school degree (OECD Education, 2005).

Figure 2

High School Attendance Statistics for Mexico\textsuperscript{6}

(In percentage terms)

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\textsuperscript{5}In the Mexican education system, elementary school consists of grades 1-6. What we term middle school corresponds to academic grades 7-9. High school consists of grades 10-12. Most Mexican children begin 1st grade at age 6.

III. LITERATURE REVIEW

Economic Theory

Economic theory suggests that individuals approach educational consumption as they would the investment or consumption decision for any other normal good (Becker, 1964). In economic theory goods can be classified into normal, inferior, ordinary or Giffen goods, most times into more than one category. A normal good is characterised by a positive relationship between changes in income and changes in demand for the good. Consumers weigh the costs and benefits of each year of education to determine the relative merit of undertaking another. Based on their preferences, individuals make present value calculations at the household level to determine the amount of schooling that will be pursued by each member. Only when the expected rates of return on the additional year supersede the indirect and direct costs will it be decided that an individual enrol in an educational institution. Even when the direct tuition costs of education are zero, as in the case of public education to different levels throughout the world, individuals face varying levels of opportunity costs through the foregone wages of years spent in school. This cost-benefit analysis is carried out at the household level. Demand for education, exists only if a family’s income resources can sustain the costs of enrolment; i.e. households face a short-term budget constraint. Theoretical modeling of the school attendance decision will be developed in more detail in section IV.

In practice, López-Acevedo (2001; 2006), Mehta and Villarreal (forthcoming) and Patrinos et al. (2006) have produced measures of the returns to education in Mexico based off of Mincer’s methodology (1974). In reviewing the factors driving inequality in Mexico, López-Acevedo has concluded that educational

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inequality accounts for the largest share of overall earnings inequality (2001). Mehta and Villarreal, on the other hand, find that income depends more heavily on sociodemographic indicators than on educational attainment. Other studies estimating the economic returns to education in Mexico over the past forty years have shown a tendency toward decreased returns over this time period (Muñoz, 1998).

Recently, several authors have utilized Cox proportional hazard models to examine the determinants of school attendance. Edwards and Ureta utilize this methodology to analyze the situation in El Salvador, and Inchauste employs it for the Bolivian case (2003; 2000). In Bolivia, Inchauste introduces various constraints potentially present in individual educational decision-making and discovers that the most pronounced probability of quitting school was found for indigenous women, and particularly for married indigenous women (groups divided according to ethnicity, sex and marital status) (2000). Edwards and Ureta conclude that the key determinant of school retention in El Salvador is parental schooling, with additional impacts affected by income and remittances (2003). The hazard model produces estimates of the probability of quitting school at period $t+1$ on a continuous scale for the chosen years of education in the respective studies.

Both studies find the Cox proportional hazard model attractive given that this particular methodology makes use of much more of the available information in a database of cross-sectional data. It does not, as do traditional school attendance methodologies, require elimination of observations conditional on the fact that each individual has terminally completed his or her formal education. Rather, the model incorporates individuals both attending and not attending school across all age groups. Additional benefits to this methodology include that it produces estimates of survival functions. These allow researchers to ascertain peak years of desertion along the educational spectrum. Additional variables may be incorporated into the model to test for the influence of sociodemographic characteristics or the model can be run in cohorts to view different desertion probabilities for different groups. The Cox proportional hazard model utilizes the maximum possible number of database observations in the study of school attendance decisions, and allows the use of the most current observations (of youth who are still school-age). This is imperative if the education attendance climate has changed dramatically in recent years within a country, as in the case of El Salvador. One drawback to the methodology is that any additional included variables must be time-consistent. Cox models are less applicable to studies of present day decisions, or in cases in which the years of higher drop out are already clearly understood (as in Mexico for example, where we know that high drop out rates are clustered around the terminal years of each education level).

Other authors have utilized quantile regression to examine the distribution of returns to education across individuals. In their cross-country synthesis of
studies, Patrinos, et al. (2006) argue that many times returns vary significantly across individuals within a state, and thus presentation only of the average returns to an average representative individual may produce biased results. In their comparison of quantile regression results across countries, Patrinos, et al. find mixed results of the returns to education in middle-income Latin American countries. They suggest that workers in Argentina, Brazil, Chile and Venezuela experienced increasing returns with upper quantiles during the 1990s. Studies of the Mexican case using 2002 data from the National Household Income and Expenditure Survey (ENIGH) find that returns to education decrease for higher socioeconomic quantiles (Patrinos, et al., 2006). OLS calculations of a quantile regression model for rates of return to years of schooling for Mexican males 25-65 years old find the average return to an additional year of schooling to be 11.3 per cent, while the expected return for the 90th quantile is only 2.4 per cent (Patrinos, et al., 2006). The overall trend in Mexico throughout the distribution still lends itself to the conclusion that education and labour skills are complementary (Patrinos, et al., 2006).

Factors Affecting Schooling Decisions

Recent studies have tested a vast array of dependent variables in an attempt to explain the demand for education in countries throughout the world (as measured through the proxy of education enrolment rates). The most common variables included will be discussed in this section. They include: household income, urban vs. rural location, sex of the child, health of the child, education levels of the parents, parental perceptions of education, the presence of migratory experience in the household, school costs and eligibility for governmental assistance programs. Labour market conditions have also been utilised as an explanatory factor and, particularly in the United States, the issue of race has been raised as an important dependent variable in the demand equation.

Particularly in Mexico, there has been less discussion of the specific factors that affect school enrolment, although there has been much published regarding the formation, planning and evaluation of education for different groups within the country (Latapí, 1998). While there is a large informal sector in the Mexico economy, the principal focus of the majority of empirical studies revolves around workers in the formal sector, due to the difficulty of obtaining reliable data for the previous. In general, the topic of high school education has received less planning, less discussion and less structure than elementary and middle school education (Martínez, 1998). It is seen as a diverse transitional period of education and the subject of a common core curriculum has been the subject for much debate (Castrejón, 1998).

The lion’s share of investigations include household income as a dependent variable to measure a family’s ability to sustain the direct, indirect and opportunity costs of sending children to school (Buchmann, 2000; Rose and Al-Samarrai, 2001; Tansel and Bircan, 2005). It is widely accepted as a proxy for capacity
to sustain a family economically without the added income were the child or children of the household to work rather than attend school.


Case studies of Tanzania, Kenya and Thailand find that gender of the child is statistically significantly correlated with their school enrolment. In the case of Tanzania, Antoine Bommier and Sylvie Lambert’s results following maximum likelihood regression indicate that males and females follow different educational patterns. These include generally fewer years of schooling for girls, and earlier termination, particularly if the girl has been held back in one or more grade levels (Bommier and Lambert, 2000). Claudia Buchmann’s investigation into enrolment in Kenya found that gender stereotypes were statistically insignificant in determining a child’s school attendance once enrolled. Rather, labour market discrimination against women accounted more correctly for the lower rates of female enrolment (Buchmann, 2000). In a similar study with Dan Brakewood, Buchmann compared the labour market conditions in Kenya with those of Thailand. The results of this investigation also support the hypothesis that gender differences in employment opportunities account for at least part of the difference in male and female educational enrolment in the study countries (Buchmann and Brakewood, 2000).

Buchmann’s study on child labour examines the role that working plays in schooling decisions (2000). Buchmann hypothesises that child labour tasks compete with school enrolment. The Buchmann study includes interaction terms measuring both job market opportunity perceptions, the number of siblings (male and female) in the household and sex of the child in question, in an attempt to measure the combined effects of these variables. Buchmann finds that child labour overall is not a factor affecting school attendance, though it does find that while few girls and boys work in the formal labour market, girls do contribute substantially to household tasks. The relationship between gender and school attendance is linked more to the total number of male versus female children in the household than to the labour status of the child.

Several papers that have aimed to explain school drop-out rates and excessive absence of students have found illness to be the primary cause (Tansel and Bircan, 2005; Rose and Al-Samarrai, 2001). These studies focus on the most poverty-stricken nations, in which the question of whether or not a child is physically well enough to enrol in school is a more present issue than it is in Mexico. Perhaps more relevant is the correlation between child health and performance once a child has enrolled in school (as discussed by Pollitt, 1989; Behrman, 1996). Although Pollitt admits the information utilized is limiting for
analysis of performance over time, he suggests that a youth’s nutritional and disease conditions can be powerful risk factors in connection with school aptitudes (1989). Behrman concludes in his 1996 study that child health and nutrition are strongly associated with educational achievement, while also including the caveat that this correlation may run in both directions (1996).

Care-givers’ perceptions and attitudes toward education are arguably also important factors in determining education enrolment of the household children. For minors it is assumed that the care-givers or parents ultimately make the educational enrolment decisions. Thus it seems logical that their views and experience will affect the choices they make for their children’s education. A commonly used proxy to measure parental perceptions toward education is the education level of the care-givers in the family (Rose and Al-Samarrai, 2001).

The effect of migration experience within the household on the school attendance of its children can arguably move in either direction. On one hand, migrated family members generate remittances, which can support children to stay in school longer. Conversely, family stress and behaviour problems due to parent or sibling absence can reduce school attendance. Migration also provides an example of an alternative option for economic mobility, other than staying in school. Four separate studies examine the impact of labour migration on educational attainment (Jones, 1998; Kandel and Kao, 2001; Edwards and Ureta, 2003; McKenzie and Rapport, 2006).

Jones combines economic and geographic lenses in his family migration survey in the Mexican state of Zacatecas. Jones believes that the lack of agreement regarding the impacts of remittances is partly due to the complexity of conditions that surround migration and remittances, and he proposes two factors to help explain these divergent views. First, inter-household inequality in Zacatecas tends to decrease in communities with increased migratory experience up to a certain point, and then inequality again increases. Second, when examined at the household level, remittances tend to improve the wealth status of families higher on the socioeconomic scale at the expense of poorer families (Jones, 1998). Improved wealth status increases the economic feasibility of sending household children to school and so remittances received by wealthy families in communities with deep and sustained migration channels may positively affect their school attendance decisions for their children. However, remittances in these community may adversely affect the school attendance of members of the poorest families.

Kandel and Kao conclude that migration of Mexican family members to the United States provides sufficient monetary benefits that children continue

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8 For a thorough discussion on the topic of income and opportunity transfer between generations, see the body of literature on Intergenerational Mobility (e.g. Solon, 2002).

9 Parental education itself also usually enters the equation indirectly through a positive reflection of increased education on income.
school and perform well, but also may decrease youths' motivation to attain above-average years of education (2001). Using IV-censored ordered probit tests, McKenzie and Rapport find evidence that among rural homes in Mexico, living in a migrant household lowers the probability of attending middle-school by 16 per cent for males (12-15 years of age). Living in a migrant household is estimated to lower the probability of attending high school by 21 per cent for males and 20 per cent for females (16-18 years of age) (McKenzie and Rapport, 2006). The probability of students from households with migrant experience completing high school is 13 and 14 per cent lower, for males and females respectively, than for students who do not live in households in which family members have migrated (McKenzie and Rapport, 2006). Conversely, Edwards and Ureta find that remittances sent from family members outside of Mexico have a large, significant and positive effect on school retention. In their study utilising a Cox proportional hazard model, they discover that in urban areas the remittance effect by itself is ten times larger than the effect other income has on school retention. In rural areas the remittance effect is 2.6 times the size of the other income effect (Edwards and Ureta, 2003).

Finally, there has been argument in academic publications over the effectiveness of government public policy programs in raising school enrolment and attendance rates. Governments must undergo policy evaluation to justify public spending on education-oriented public policy. These evaluations may substantiate or invalidate government programs. In their effort to examine public policy effects of increased spending on public education, Era Dabla-Norris and John Matovu simulate government spending policy changes (2002).

Dabla-Norris and Matovu develop a model demonstrating that decreasing the costs of primary education for households through government programs can potentially increase overall educational attainment. These increases in turn, are expected to have a positive impact on macroeconomic growth and poverty-reduction (2002). According to their model, the largest growth and poverty-reducing effects will be witnessed when primary education costs are decreased relative to secondary or tertiary education costs. Increases in government expenditure on secondary and tertiary education realize lower positive growth and poverty-reduction effects, due to the larger fixed costs of these levels of education. However, once near universal primary education attainment is achieved, (as in the case of Mexico) Dabla-Norris and Matovu’s findings suggest that spending on secondary and tertiary education has important implications for long-run economic growth (Dabla-Norris and Matovu, 2002)

In the case of the United States, Mark Fetler discovered that higher dropout rates were positively correlated with families who received assistance from the government program Aid to Families with Dependent Children (AFDC) in the United States (1989). The study built upon previous studies which controlled for

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10 As noted in Figure 2, average educational attainment in Mexico is approximately 8.2 years, or partial middle school completion.
gender, race, age, student achievement, school size and poverty level. Fetler’s research question regarding the relationship between school achievement and course enrolment utilised AFDC as a poverty indicator for a given school’s population. Thus, receipt of AFDC directly served to measure the income or poverty effect on school drop out rates (1989).

Specifically in Mexico, the school attendance ramifications of the Oportunidades and PROCAMPO programs have been analyzed (Bando, López-Calva and Patrinos, 2005; Bereznak, 2007). Bando, López-Calva and Patrinos utilized panel data from the late 1990s to conclude that final education level attainment increased among indigenous children who participated in Oportunidades (2005). Studies preliminary to this research produced a negative correlation between a family’s receipt of funds from PROCAMPO (Program for Direct Assistance in Agriculture, which provides cash transfers to Mexican farmers affected by NAFTA) and the household children’s school attendance (Bereznak, 2007).

Other common variables mentioned as potential determinants of the demand for education at the family level are race and labour market conditions. Buchmann and Brakewood’s conclusions indicate that perhaps in many countries if labour market discrimination against women is prevalent, the perceived returns to sending a female child to school could be lower than the perceived returns to education for male children (2000). Particularly in studies focused on the United States, statistics have demonstrated that minorities continue to face education and labour market discrimination. Fewer minority students finish each level of schooling, dropout rates for these groups is higher, and in the labour market they tend to earn lower remuneration than their equally qualified, white peers (Allen et al., 2002; Borjas, 2005).

The data used and variables incorporated into the Participant Characteristics model will be detailed in sections IV and V.

IV. DATA

Data for this study were obtained from two separate surveys conducted in Mexico in 2004 by the National Institute of Statistics, Geography and Information (INEGI for its initials in Spanish). INEGI is a public organization of the Mexican government dedicated to statistical acquisition. The 2004 National Household Income and Expenditure Survey (ENIGH for its initials in Spanish) provides the majority of the data, including sociodemographic and household characteristics. A supplementary survey, the 2004 Social Programs Module, focuses on household receipt of government social assistance. This data provided more detailed information on household receipt of public funds for academic scholarships, as well as from the Oportunidades and PROCAMPO programs.

The databases used for the Economic Returns to Education regressions contained all monetarily compensated workers between the ages of 16 and 65 who
gender, race, age, student achievement, school size and poverty level. Fetler’s research question regarding the relationship between school achievement and course enrolment utilised AFDC as a poverty indicator for a given school’s population. Thus, receipt of AFDC directly served to measure the income or poverty effect on school drop out rates (1989).

Specifically in Mexico, the school attendance ramifications of the Oportunidades and PROCAMPO programs have been analyzed (Bando, López-Calva and Patrinos, 2005; Bereznak, 2007). Bando, López-Calva and Patrinos utilized panel data from the late 1990s to conclude that final education level attainment increased among indigenous children who participated in Oportunidades (2005). Studies preliminary to this research produced a negative correlation between a family’s receipt of funds from PROCAMPO (Program for Direct Assistance in Agriculture, which provides cash transfers to Mexican farmers affected by NAFTA) and the household children’s school attendance (Bereznak, 2007).

Other common variables mentioned as potential determinants of the demand for education at the family level are race and labour market conditions. Buchmann and Brakewood’s conclusions indicate that perhaps in many countries if labour market discrimination against women is prevalent, the perceived returns to sending a female child to school could be lower than the perceived returns to education for male children (2000). Particularly in studies focused on the United States, statistics have demonstrated that minorities continue to face education and labour market discrimination. Fewer minority students finish each level of schooling, dropout rates for these groups is higher, and in the labour market they tend to earn lower remuneration than their equally qualified, white peers (Allen et al., 2002; Borjas, 2005).

The data used and variables incorporated into the Participant Characteristics model will be detailed in sections IV and V.

**IV. DATA**

Data for this study were obtained from two separate surveys conducted in Mexico in 2004 by the National Institute of Statistics, Geography and Information (INEGI for its initials in Spanish). INEGI is a public organization of the Mexican government dedicated to statistical acquisition. The 2004 National Household Income and Expenditure Survey (ENIGH for its initials in Spanish) provides the majority of the data, including sociodemographic and household characteristics. A supplementary survey, the 2004 Social Programs Module, focuses on household receipt of government social assistance. This data provided more detailed information on household receipt of public funds for academic scholarships, as well as from the Oportunidades and PROCAMPO programs.

The databases used for the Economic Returns to Education regressions contained all monetarily compensated workers between the ages of 16 and 65 who
All regressions and statistical analysis were conducted utilizing the statistical computational software STATA 9.

**Figure 4**

**Average Educational Attainment by Group: Nuevo León and Mexico**
(Using INEGI 2004 ENIGH data)

<table>
<thead>
<tr>
<th>Nuevo León</th>
<th>All residents older than 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Mean</td>
</tr>
<tr>
<td>7843</td>
<td>9.581538</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mexico</th>
<th>All residents older than 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Mean</td>
</tr>
<tr>
<td>56792</td>
<td>8.853465</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nuevo León</th>
<th>All paid workers 16-65 years old that work 10-80 hours per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Mean</td>
</tr>
<tr>
<td>1694</td>
<td>10.53601</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mexico</th>
<th>All paid workers 16-65 years old that work 10-80 hours per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Mean</td>
</tr>
<tr>
<td>9149</td>
<td>10.26681</td>
</tr>
</tbody>
</table>

Additionally, two interviews were conducted with members of the Mexican Secretary's Office of Public Education (SEP) in the state of Nuevo León. We held interviews with the Director of the Federal Services Office and the State SEP Coordinator. These interviews were structured with open-ended questions. As the objective behind them was to obtain qualitative, realistic insight into the situation of high school education in the state, we allowed the conversations to be highly guided by the perceptions, expertise and information revealed by the interviewees themselves.

V. EMPIRICAL FRAMEWORK
worked between 10 and 80 hours a week. The Probit regression models contained observations only of individuals between the ages of 15 and 19 who had completed middle school and had yet to complete high school. Data utilised to calculate the theoretical behaviour model calibrations were taken from our regression results and Returns to Education model validation. See Figure 4 for a descriptive table of educational attainment by group for Mexico and Nuevo León.

All regressions and statistical analysis were conducted utilizing the statistical computational software STATA 9.

Figure 4

Average Educational Attainment by Group: Nuevo León and Mexico
(Using INEGI 2004 ENIGH data)

<table>
<thead>
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</tr>
<tr>
<td>7843</td>
<td>9.581538</td>
</tr>
</tbody>
</table>

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<tr>
<td>Observations</td>
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<tr>
<td>1694</td>
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<tr>
<td>56792</td>
<td>8.853465</td>
</tr>
</tbody>
</table>

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<tr>
<td>Observations</td>
</tr>
<tr>
<td>9149</td>
</tr>
</tbody>
</table>

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V. EMPIRICAL FRAMEWORK
Estimating the Economic Returns to Education

When a household or individual makes their education consumption decisions, they consider the expected economic returns to investing the time in each additional year of schooling. Most studies estimating the returns to education are based on the work of Mincer (1974). We also followed this methodology, including splines to allow for changing returns to each year of education according to school level.

Model Functional Form

The general Mincerian returns regression is structured as follows:

\[ \ln W = \alpha_0 + \sum \beta_i D_i + \delta_0 E + \delta_1 E^2 \]  

Where \( \ln W \) is the natural log of wages earned by an individual, \( D \) is a dummy variable that takes the value of 1 if a given year of education was completed, and \( E \) is the number of years of work experience the individual has (age minus years of education is equal to the age at which formal schooling is begun (5 for preschool)). The \( E^2 \) term allows decreasing rates of return to experience. A second variation of Mincer’s methodology includes any number of splines to measure added effects for additional years of education beyond each school level. This allows a better fit to the logarithmic shaped data. The model we employ provides information on the economic returns to each year of education (above the salary obtained by individuals with out any formal education). We create the traditional model, where \( y \) measures the return to years of elementary education, \( E \) measures returns to years of work experience and \( E^2 \) measures returns to years of experience squared. Additionally, we add four splines, which measure additional returns for post elementary years (\( el \times (y - 7) \)), post middle school years (\( ms \times (y - 10) \)), post high school years (\( hs \times (y - 13) \)), post university years (\( un \times (y - 17) \)) (see Hungerson and Solon, 1987).

\[ \ln W = \alpha + \beta_0 y + \beta_1 \times el(y - 7) + \beta_2 \times ms(y - 10) + \beta_3 \times hs(y - 13) + \beta_4 \times un(y - 17) + \delta_0 E + \delta_1 E^2 \]  

The \( \beta \)'s are splines, the sum of which provides the slope of the log-wage function at a given level of education. In this equation, The variable \( y \) is the number of years of education completed. The variables \( el, ms, hs, un \) are indicators that take the value of 1 if that particular level of education was
completed. \( el = \) elementary school, \( ms = \) middle school, \( hs = \) high school, \( un = \) university or college). 7, 10, 13 and 17 are the total number of years of education required for completion at each above mentioned level in Mexico, taking into account one year of preschool and that children begin elementary school at age 6. So as to measure schooling according to years of education, as well as take into account equivalent technical education, the formal education classifications constructed by INEGI were deconstructed and education was defined in number of formal schooling. The new classification ranged from 0 years (no formal education) to 19 years (graduate studies completed).

There are a number of additional variations on the traditional Mincerian model, including the addition of sociodemographic variables that may affect individual rates of returns to education and the inclusion of time preferences to account for the opportunity costs associated with choosing schooling over work in the current period. Our model was regressed without the inclusion of sociodemographic variables. Our objective in this paper is to discover who decides to attend high school and who decides not to attend. To this end, our objectives in running this returns to education model are: statistically measure the contributions of years of education to income (to see if there are economic incentives to attend high school), use these results to calculate predicted salaries, and test our data within the behavioral model including more realistic conditions and discounting for time preferences (to measure if the utility maximizing attendance decision changes). Our research question does not search to answer the question of whether different sociodemographic groups realize different returns to education; we leave this question to future studies. For general interest, however, we include a snapshot of the sociodemographic profile of the workers in this model’s data set in Figure 5.

**Figure 5**

**Sociodemographic Characteristics: Nuevo León and Mexico**

<table>
<thead>
<tr>
<th></th>
<th>Nuevo León</th>
<th>Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean age</td>
<td>34.9</td>
<td>35.5</td>
</tr>
<tr>
<td>percent male</td>
<td>77.10%</td>
<td>66.80%</td>
</tr>
<tr>
<td>mean years of education</td>
<td>10.5</td>
<td>10.3</td>
</tr>
<tr>
<td>mean hours worked per week</td>
<td>47.2</td>
<td>47.1</td>
</tr>
<tr>
<td>mean hourly salary (in Mexican pesos)</td>
<td>27.7</td>
<td>26.3</td>
</tr>
<tr>
<td>mean years of experience</td>
<td>19.3</td>
<td>20.2</td>
</tr>
</tbody>
</table>

The regressions were run utilizing a standard weighted OLS procedure, which ensured that our data was representative of the population. The resulting coefficients can be interpreted as the percentage increase in wages attributable to each additional year of schooling or experience in the education and work
variables. Given that most of the indirect costs of education are comprised of foregone wages, these predicted wage increases can be utilized to estimate the private rates of return to investments in education. In this model, any direct costs of education, including private school tuition and fees, are not taken into account.

Model Results and Interpretation

Using the Mincerian equation with splines (11), the model was run both for the state of Nuevo León and the country of Mexico as a whole. The sample included monetarily remunerated employees between the ages of 16 and 65 who reported working between 10 and 80 hours per week in 2004. Income from non-salary sources was not included. The results for economic returns to education and experience are listed in Figure 6.

Figure 6

Returns to Education: Nuevo León and Mexico
(Weighted regression results)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Nuevo León Coefficient</th>
<th>Robust Std. Error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>years edu.</td>
<td>0.0164557</td>
<td>0.0109385</td>
<td>0.133</td>
</tr>
<tr>
<td>middle school</td>
<td>0.0727732</td>
<td>0.0207068</td>
<td>0.000</td>
</tr>
<tr>
<td>high school</td>
<td>-0.006886</td>
<td>0.0231964</td>
<td>0.773</td>
</tr>
<tr>
<td>university</td>
<td>0.0853853</td>
<td>0.0297404</td>
<td>0.04</td>
</tr>
<tr>
<td>grad school</td>
<td>0.3303585</td>
<td>0.134857</td>
<td>0.014</td>
</tr>
<tr>
<td>E</td>
<td>0.0425559</td>
<td>0.0039023</td>
<td>0.000</td>
</tr>
<tr>
<td>E2</td>
<td>-0.0006217</td>
<td>-0.000554</td>
<td>0.000</td>
</tr>
<tr>
<td>constant</td>
<td>2.039946</td>
<td>0.0816809</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Assuming 30 years of work experience (to illustrate mid-career workers), predicted monthly salaries were calculated with the obtained estimators. Although the additional returns to years of high school variable was not statistically significant, it was utilized in the salary calculations for three reasons: first, it carried economic justification for its inclusion; second, given the accumulative form of the equation we would only be able to discard the variable’s significance with a delta method joint significance test; and third, the coefficient is so small that its affect on the salary calculations was miniscule. Regardless, the regression results obtained dropping the variable high school and the corresponding calculated salaries are included below for comparison.
Figure 7

**Calculated Average Monthly Salaries: Nuevo León**  
(Utilitying above regression results including high school variable, with 30 years work experience)

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Years of Education</th>
<th>Est. ln(wage)</th>
<th>Est. Monthly Salary (MXN pesos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.790</td>
<td>$3,305</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.806</td>
<td>$3,358</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2.822</td>
<td>$3,413</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2.838</td>
<td>$3,468</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2.854</td>
<td>$3,523</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2.870</td>
<td>$3,580</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2.886</td>
<td>$3,638</td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>7</td>
<td>2.902</td>
<td>$3,697</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>2.991</td>
<td>$4,040</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>3.079</td>
<td>$4,414</td>
</tr>
<tr>
<td>Lower-secondary</td>
<td>10</td>
<td>3.168</td>
<td>$4,824</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>3.251</td>
<td>$5,240</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>3.334</td>
<td>$5,691</td>
</tr>
<tr>
<td>upper-secondary</td>
<td>13</td>
<td>3.416</td>
<td>$6,182</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>3.584</td>
<td>$7,311</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>3.752</td>
<td>$8,646</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>3.919</td>
<td>$10,224</td>
</tr>
<tr>
<td>university</td>
<td>17</td>
<td>4.087</td>
<td>$12,091</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>4.585</td>
<td>$19,889</td>
</tr>
<tr>
<td>graduate school</td>
<td>19</td>
<td>5.082</td>
<td>$32,716</td>
</tr>
</tbody>
</table>

Figure 8

**Returns to Education: Nuevo León and Mexico**  
(Weighted regression results, excluding "high school")

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Coefficient Nuevo León</th>
<th>Robust Std. Error Nuevo León</th>
<th>p-value</th>
<th>Coefficient Mexico</th>
<th>Robust Std. Error Mexico</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>years edu.</td>
<td>0.0172879</td>
<td>0.0550494</td>
<td>0.0107005</td>
<td>0.0511812</td>
<td>0.0106112</td>
<td>0.160</td>
</tr>
<tr>
<td>middle school</td>
<td>0.0688051</td>
<td>0.0595451</td>
<td>0.0163746</td>
<td>0.0142793</td>
<td>0.0142793</td>
<td>0.000</td>
</tr>
<tr>
<td>university</td>
<td>0.0800715</td>
<td>0.0550494</td>
<td>0.0107005</td>
<td>0.0511812</td>
<td>0.0106112</td>
<td>0.160</td>
</tr>
<tr>
<td>grad school</td>
<td>0.3324323</td>
<td>0.2935196</td>
<td>0.1345183</td>
<td>0.053538</td>
<td>0.053538</td>
<td>0.014</td>
</tr>
<tr>
<td>E</td>
<td>0.0425871</td>
<td>0.0425871</td>
<td>0.0039015</td>
<td>0.002467</td>
<td>0.002467</td>
<td>0.000</td>
</tr>
<tr>
<td>E2</td>
<td>-0.00006232</td>
<td>-0.00006232</td>
<td>0.0000796</td>
<td>0.0000476</td>
<td>0.0000476</td>
<td>0.000</td>
</tr>
<tr>
<td>constant</td>
<td>2.039506</td>
<td>1.522797</td>
<td>0.081745</td>
<td>0.0712855</td>
<td>0.0712855</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Number of obs.       | 1694                   | 9149                         | 0.3438    | 0.394              | 0.394                    | 0.000     |
Figure 9

Calculated Average Monthly Salaries: Nuevo León
(Utitlising above regression results without high school variable, with 30 years work experience)

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Years of Education</th>
<th>Est. ln(wage)</th>
<th>Est. Monthly Salary (MXN pesos)</th>
</tr>
</thead>
<tbody>
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<td>0</td>
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<td>$3,305</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.807</td>
<td>$3,362</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2.824</td>
<td>$3,419</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2.841</td>
<td>$3,478</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2.858</td>
<td>$3,538</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2.875</td>
<td>$3,598</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2.892</td>
<td>$3,660</td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>7</td>
<td>2.909</td>
<td>$3,723</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>2.995</td>
<td>$4,057</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>3.081</td>
<td>$4,421</td>
</tr>
<tr>
<td>Lower-secondary</td>
<td>10</td>
<td>3.167</td>
<td>$4,818</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>3.253</td>
<td>$5,251</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>3.339</td>
<td>$5,723</td>
</tr>
<tr>
<td>upper-secondary</td>
<td>13</td>
<td>3.425</td>
<td>$6,237</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>3.591</td>
<td>$7,363</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>3.757</td>
<td>$8,692</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>3.923</td>
<td>$10,262</td>
</tr>
<tr>
<td>university</td>
<td>17</td>
<td>4.089</td>
<td>$12,115</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>4.585</td>
<td>$19,895</td>
</tr>
<tr>
<td>graduate school</td>
<td>19</td>
<td>5.081</td>
<td>$32,670</td>
</tr>
</tbody>
</table>

The monthly salaries at the upper end of the education distribution may appear to be slightly low for the quantity of work experience utilized in the calculations. However, there were several characteristics present that may have provoked these lower values. First, the database ENIGH captured net, rather than gross salaries. Second, Mexico possesses a progressive tax system and thus in upper income ranges we can assume that gross income is 20 to 25 per cent higher than the calculated figures. We also may be witnessing a traditional problem of under reporting within higher socioeconomic classes faced by most household surveys, which could bias the obtained salary data downward. As anticipated, the model is heteroscedastic, due to increasing salary variance with years of education (see figure 10). López-Acevedo has examined the contribution of education to inequality in Mexico (2001; 2007). However, her studies have utilised inequality measures known as generalized entropy indexes as the basis for her analysis. López-Acevedo’s calculation of the contribution of education to income inequality is reported as a percentage of the total, and thus is difficult to compare directly to our calculations of percentage increases in the economic return to each additional year of education. By functional form, the education splines in the returns model are endogenous. As in any model the
mincerian form with splines has its weaknesses. In our case, there are any number of unobservable characteristics within the population that may affect the coefficients. Unfortunately, though the results would inevitably be strengthened by additional information, our data and the model limit our ability to control for these characteristics.

**Figure 10**

**Observed Values vs. Regression Fit**

\(\ln W = \ln(\text{hourlywage}), y = \text{years of education}\)

In Nuevo León, results found for the economic returns to education at schooling different levels were much more marked than those seen at the national level. Years of middle school education were observed to augment earnings significantly (7.3 per cent per year). The negative coefficient for the years of high school variable should not be interpreted as if high school education were correlated with lower salaries. Due to the model construction, the economic return to each year of education was cumulative (i.e. the sum of the coefficients for each year produces the total return multiplier). A negative estimator indicated that, while years of high school education did produce higher wages due to the sum of the previous splines’ returns, salaries increased at a decreasing rate. Given the lack of statistical significance of the variable \(hs\), we could not conclude with certainty that years of high school education were at all correlated with earnings. Workers in Nuevo León again realized substantial returns to education.
at the university level (9 per cent per year). Experience played an important role in the earnings equation. It was correlated with an average increase of 4.2 per cent per year of experience, though experience produced higher returns at decreasing rates over time.

In the country as a whole, the returns to education were more evenly distributed over the education life-cycle. High school was still not statistically correlated with earnings, but the coefficient estimated was positive (1.4 per cent). Returns to university education were more in line with the returns to years of elementary and middle school. Graduate school produced important returns in both Nuevo León and the country as a whole. Experience was an equally important factor at the national level as in Nuevo León. The only variable whose coefficient was statistically different between the state and national regressions was years of education ($y$).

**Identification of Participant Characteristics:**
**Probit Model**

The data presented in the introduction (Figures 2 and 3) demonstrated the drop off in school participation after middle school in Mexico. Given the results from the previous section, we have reason to suspect that the lack of economic returns to high school education is a significant explanatory component for this phenomenon. A question of interest now becomes, which groups of adolescents were less likely to attend high school? What were the characteristics that can assist us in identifying groups with a higher risk of drop-out? If our aim is to consider public policy options that increase educational attainment at the high school level, we must first be able to target the individuals that would benefit most greatly from such programs. With this objective, we apply a standard discrete intertemporal probabilistic model to the population in question to find key characteristics.

**Model Functional Form**

The dependent variable, school enrolment, was binary and thus lent itself to the functional regression form of a probit model. For ease of interpretation, an alternative probit model was run which fit a maximum-likelihood probit model and reported the marginal effect of each independent variable. In other words, the coefficients could be interpreted as the change in the probability of success (school attendance) for an incremental change in each independent, continuous variable. The coefficients reported the discrete change in the probability for dummy variables. The probabilistic model was defined as follows:

$$P(y_i \neq 0 \mid x_i) = \phi(x_i b)$$  \hspace{1cm} (3)
Where $\phi$ is a cumulative distribution function (cdf) of a normally distributed function, and $(x_i b)$ is the normally distributed probit score.

The regression equation for the state-level model estimated is:

$$
school = \alpha + \beta_0 \text{inc} + \beta_1 \text{sex} + \beta_2 \text{work} + \beta_3 \text{malework} + \beta_4 \text{totkids} \\
+ \beta_5 \text{rural} + \beta_6 \text{sexhh} + \beta_7 \text{edhh} + \beta_8 \text{apor} + \beta_9 \text{oschol} \\
+ \beta_{10} \text{proca} + \varepsilon \quad (4)
$$

For comparison purposes between the state of Nuevo León and the country of Mexico as a whole, the final regression is tested identically for both samples.

The variables are defined below, along with relevant explanatory notes.

**school** – A binomial variable that takes the value of 1 if the adolescent attended school in the 2003-2004 school year and the value 0 if they did not attend school.

**inc** – The natural logarithm of household income, so as to measure the effects per cent changes income have on school attendance, rather than changes in monetary units.

The logarithmic form of the income variable allows the model to capture the greater effect of a change in income on school attendance for poorer families than the same monetary change in income would affect on education enrolment decisions for households in the upper thresholds of the socioeconomic distribution. Expenditure data, rather than income, is used so as to ameliorate problems of endogeneity in receipt of program funds (PROCAMPO, Oportunidades) and income. Total household monthly expenditure is calculated by INEGI.

**sex** – A binary variable that takes the value of 1 if the adolescent is male and the value of 0 if they are female.

**work** – A binary variable that takes the value of 1 if the adolescent reported to be working, either remunerated or non-remunerated positions, during 2004, and the value of 0 if they did not report working.

**malework** – A binary variable that takes the value of 1 if the adolescent is both male and reported working during 2004, and takes the value of 0 otherwise,
so as account for interaction effects and the tendency in the data for working adolescents to be primarily male.

\( \text{totkids} \)– The total number of children ages 0-19 in the household.\(^{11} \)

\( \text{rural} \)– A binary variable that takes the value 1 if the household is located in an area with fewer than 2,500 inhabitants and the value 0 if the household is located in an area with more than 2,500 residents.

\( \text{sexhh} \)– A binary variable that takes the value of 1 if the head of household is male and the value of 0 if the head of household is female.

\( \text{edhh} \)– The level of education attained by the head of the household, classified by completion of each level of education: 1=pre-school and/or elementary incomplete, 2=elementary complete, 3=middle school incomplete, 4=middle school or equivalent technical school complete, 5=high school incomplete, 6=high school or equivalent technical school complete, 7=college or other post high school incomplete, 8=college complete, 9=masters or doctoral studies.

\( \text{opor} \)– A binary variable that takes the value of 1 if the individual did not receive support from the program oportunidades in 2004, but at least one other member within the household did receive support from oportunidades, and takes the value of 0 otherwise.\(^{12} \)

\( \text{oschol} \) - A binary variable that takes the value of 1 if the individual did not receive support from a scholarship program other than oportunidades in 2004, but at least one other member within did receive a scholarship, and takes the value of 0 otherwise.

\( \text{procampo} \)– A binary variable that takes the value 1 if any member within the household received support from the PROCAMPO program sometime during the time period from January 1, 2004 to the survey date.\(^{13} \)

Excluded Variables

\(^{11}\)In our model we include individuals up to age 19 as potential high school age students. For consistency, we place the cut off age for an individual to be considered a child at this age as well.

\(^{12}\)This and the \( \text{oschol} \) variable were so constructed to test for any remaining motivation or psychological effect of the household receipt of these variables.

\(^{13}\)Surveys were conducted between August 10th and November 14th, 2004.
Household location in different regions of Mexico may affect the probability that an adolescent attends school. However, in our case this variable could be only tested in the national equation. It was omitted to maintain comparability between the national and state models.

Individual receipt of scholarship support from either the government program Oportunidades or a different source were found to be nearly perfectly correlated with school attendance. We expect the income effect of support to be captured by the income variable in the equation. In the remaining effect, given that both receipt of Oportunidades support and the lion’s share of scholarship are conditional upon school attendance, we were confronted with a serious problem of identification. We considered including these variables if any member of the household receiving support from Oportunidades or another scholarship source, including the individual adolescent in question. However, this does not remove the issue of conditionality. We introduce the variables as a dummy which takes the value of 1 only if the individual adolescent does not receive support, but at least one other member in the household does. The objective is to measure any potential motivation effect the presence of scholarship support in the household may have on an individual’s perceptions or attitudes toward school.

As noted in the literature review, it would have been desirable to include variables accounting for the ethnicity of the family, labour market conditions, health of the children, migratory experience and educational level of both the mother and the father. Health, labour market conditions and ethnicity were not included due to the limitations of the data set that was utilized for this study. Data examined from other sources suggest that ethnicity is not a statistically significant predictor of school attendance behaviour in Nuevo León.\footnote{This was ascertained through preliminary regressions calculated with data from the 2002 MXFSL. Additionally, according to INEGI the indigenous-language speaking population in the state of Nuevo León was 0.8\% in 2005, only a very small percentage of the populace.} Although ENIGH did provide information on whether the household had one or more members living outside of Mexico in 2004, not a single observation in the 2004 Nuevo León database reported this as the case. This was not overly surprising given the strong economy and the fact that Nuevo León is not a high out-migration state. Due to this limitation in the data at the state level, this variable was ultimately not included in the model.

Education levels of the mother and father in the household were not calculated separately (only the education level for the head of household was included) for two reasons. First, the information on educational attainment for the second adult in the household (spouse) was limited in the data set, and would have required removal of extensive numbers of observations. Second, due to the fact that there are single-parent households in the survey, the inclusion of two separate variables could bias the regression results. If the observations with single-parent households were dropped, the sample would lose all of the
The decision was made to use the level of education attained by the head of household rather than each parent individually. This inevitably provided less information than if both variables were included, particularly as several scholars have noted that the mother’s education level tends to be significant in determining the educational attainment of female children (see e.g. Borjas, 2005; Lynn, 2003). However, the main motivator for the inclusion of parental education in the model was to serve as a proxy for parental perceptions of the importance of education; which should be largely manifested through the head of household’s educational level.

Figure 11

Sociodemographic Characteristics of Probit Study Sample
(Individuals 15-19 years old with middle school studies completed, high school studies not completed)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>School attendance</td>
<td>50.4%</td>
</tr>
<tr>
<td>Average household quarterly expenditure</td>
<td>$37,707</td>
</tr>
<tr>
<td>Percentage of population male</td>
<td>52.0%</td>
</tr>
<tr>
<td>Average education of the head of household</td>
<td>Some High School</td>
</tr>
<tr>
<td>Average total number of children in the household</td>
<td>2.58</td>
</tr>
<tr>
<td>Percentage of households in rural areas</td>
<td>11.4%</td>
</tr>
<tr>
<td>Percentage adolescent receipt of Opportunities</td>
<td>2.6%</td>
</tr>
<tr>
<td>Percentage household receipt of Opportunities</td>
<td>4.5%</td>
</tr>
<tr>
<td>Percentage adolescent receipt of a different scholarship</td>
<td>3.8%</td>
</tr>
<tr>
<td>Percentage household receipt of a different scholarship</td>
<td>7.3%</td>
</tr>
</tbody>
</table>

Model Results and Interpretation

The model was regressed with two different specifications. The first included individuals residing in the Mexican state of Nuevo León, who were 15-19 years old and had completed middle school but had not completed high school. The second included individuals of the same age group and educational classification nationwide. Both regressions were run with the sets of above listed dependent and independent variables.

The probit regression for high school enrolment in Nuevo León produced a pseudo $R^2$ value of 0.29 (see results in Figure 12). We accepted this value as sufficient given the generally lower values achieved in cross-section data models. As expected, the variables logarithm of household income, sex, whether the individual works, total number of children in the household and education of the head of household were all statistically significantly correlated with high school attendance at either the 99 per cent or 95 per cent confidence interval. Although the interaction variable for male adolescents who work, household location in a rural area, sex of the head of household, a family member’s receipt
of a scholarship and family receipt of support from the government program PROCAMPO were all insignificant, these variables were not removed from the model to maintain the ability to compare between the state and national models.

**Figure 12**

**Probit Regression Results: Nuevo León and Mexico**

(Individuals 15-19 years old with middle school studies completed, high school studies not completed. weighted results)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>dF/dx Nuevo León</th>
<th>Robust Std. Error Nuevo León</th>
<th>Robust Std. Error Mexico</th>
<th>p-value Nuevo León</th>
<th>p-value Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>income</td>
<td>0.2760003</td>
<td>0.0478288</td>
<td>0.021327</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>sex</td>
<td>0.1988606</td>
<td>0.0564373</td>
<td>0.031795</td>
<td>0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>work</td>
<td>-0.4658559</td>
<td>0.0743917</td>
<td>0.041868</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>malework</td>
<td>-0.1821914</td>
<td>0.1147865</td>
<td>0.057744</td>
<td>0.122</td>
<td>0.000</td>
</tr>
<tr>
<td>totkids</td>
<td>-0.0899093</td>
<td>0.0278847</td>
<td>0.009455</td>
<td>0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>rural</td>
<td>-0.0040511</td>
<td>0.1055697</td>
<td>0.036987</td>
<td>0.969</td>
<td>0.737</td>
</tr>
<tr>
<td>sexhh</td>
<td>-0.0198666</td>
<td>0.0609294</td>
<td>0.036796</td>
<td>0.745</td>
<td>0.535</td>
</tr>
<tr>
<td>edhh</td>
<td>0.0349077</td>
<td>0.0131378</td>
<td>0.006799</td>
<td>0.008</td>
<td>0.000</td>
</tr>
<tr>
<td>opor</td>
<td>0.2827368</td>
<td>0.1130929</td>
<td>0.035935</td>
<td>0.046</td>
<td>0.133</td>
</tr>
<tr>
<td>oschol</td>
<td>-0.0180796</td>
<td>0.1908598</td>
<td>0.051616</td>
<td>0.924</td>
<td>0.001</td>
</tr>
<tr>
<td>procampo</td>
<td>0.0725816</td>
<td>0.2161144</td>
<td>0.049633</td>
<td>0.742</td>
<td>0.118</td>
</tr>
<tr>
<td>Number of obs</td>
<td>603</td>
<td>4267</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R^2</td>
<td>0.3083</td>
<td>0.2393</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By far the most important variable in predicting school enrolment was the employment status of the individual, which decreased the probability of attendance by 46 per cent. Other important factors included family income, which increased the probability of school attendance by 27 per cent for each 100 per cent increase in income, sex (being male raised the probability of high school attendance by 20 per cent in Nuevo León), and if a household member other than the individual received support from Oportunidades (which increased the adolescent’s probability of attendance by 28 per cent). The probability of school enrolment for high school students fell by 9 per cent for each incremental rise in the total number of children in the household. Likewise, for an additional level of education of the head of household, the probability that the adolescent attended high school rose 3.5 per cent.

Contrary to hypothesized, none of the following variables were statistically significantly correlated with high school attendance: rural location, sex of the head of household, receipt of assistance from the government program PROCAMPO, receipt of scholarship by a member of the household other than the adolescent in question. The variable mig was dropped because not a single observation in the state data set reported having a household member living outside of Mexico at the time of the survey in 2004. The percentage of rural
households in Nuevo León was nearly half that of the national average, which made it plausible to believe that this variable may not have been statistically important within Nuevo León. As agriculture does not comprise a large percentage of the economic activity in Nuevo León, this result was also not overly surprising. Very few observations in the state data set reported participation in the PROCAMPO program. The data indicate that 40 per cent of males age 15-19 in Nuevo León work, while only 25 per cent of females do. Apparently the interaction effect was not sufficiently strong to manifest in the regression. No readily apparent explanation was found for the irrelevance of the gender of the head of household variable. In the Nuevo León data set, the average education of the head of household in female headed households is lower than the average education of male headed households. A slightly lower percentage of adolescents in female headed households attend high school (47 vs. 51 per cent in male headed households) and a higher percentage of youth in these homes work (38 vs. 31 per cent in male headed households). Whereas 12 per cent of male headed households are located in rural areas, only 8 per cent of households are that are headed by females.

At the national level, the probit regression model for high school enrolment in Mexico explained 23 per cent of the variation in the data set. Again, the variables logarithm of household income, sex, whether the individual works, total number of children in the household, education of the head of household were all statistically significantly correlated with high school attendance. Rural household location, sex of the head of household, if a household member other than the individual adolescent received support from Oportunidades, whether a household member other than the individual adolescent received a scholarship and receipt of assistance from the government program PROCAMPO were not statistically correlated with school enrolment. The interaction variable for working males was statistically significant at the 99 per cent confidence interval. As detailed in Figure 12 and in the following paragraph, the importance of the variables spread out over the indicators, though still centered strongly around the work and sex-related variables.

The most important variables in predicting school enrolment in Mexico nationwide were similar to those found in the state of Nuevo León. These were: employment status of the individual (employment decreased probability of attendance by 33 per cent), family income (a 100 per cent increase in income increased the attendance probability by 15 per cent) and being a working male (decreased the probability of attendance by 26 per cent). Males were 18 per cent more likely to attend high school than females. The probability of school attendance grew less significantly in Mexico as a whole than specifically in Nuevo León as total household income rose. Though the total number of children was less significant in impacting school attendance decisions at the national level than in Nuevo León, the education level of the head of household carried more weight. The only variables whose coefficients were statistically different between the state and national regressions were household income and total number of
children in the household.

All regressions were run with robust standard errors so as to correct for anticipated heteroscedasticity between school attendance and the independent variables income, total children in the household and education of the head of household. The regressions were weighted for population representativity utilizing the expansion factors provided by INEGI. Additionally, correlation tests were conducted between independent variables to detect problems of multicollinearity. As previously noted, the construction of the financial support variables for Oportunidades and other scholarship programs was manipulated due partly to the presence of this correlation. Endogeneity tests confirmed that the income variable is not correlated with the error term. However, income is statistically correlated with all of the other independent variables at the 90 per cent confidence interval, according to a simple OLS regression (see Figure 13 for a correlation table). Several instrumental variables were tested in place of income, though none proved to be good instrument. We acknowledge the continuing existence of correlation between income and the other independent variables. Even so, the data show that the majority of the individual variables carry sufficient importance to demonstrate statistical significance in the probit regression. Due to the lack of a strong instrumental variable, the decision was made to maintain the model functional form as detailed above in the Model Functional Form section.

Figure 13

Correlation Table: Income and other Independent Variables
(Nuevo León probit model data set)

<table>
<thead>
<tr>
<th></th>
<th>income</th>
</tr>
</thead>
<tbody>
<tr>
<td>sex</td>
<td>0.0976</td>
</tr>
<tr>
<td>work</td>
<td>-0.0925</td>
</tr>
<tr>
<td>malework</td>
<td>-0.0918</td>
</tr>
<tr>
<td>totkids</td>
<td>0.0391</td>
</tr>
<tr>
<td>rural</td>
<td>-0.2536</td>
</tr>
<tr>
<td>sexhh</td>
<td>0.1193</td>
</tr>
<tr>
<td>edhh</td>
<td>0.5124</td>
</tr>
<tr>
<td>opor</td>
<td>-0.2198</td>
</tr>
<tr>
<td>oschol</td>
<td>0.0456</td>
</tr>
<tr>
<td>procampo</td>
<td>-0.1745</td>
</tr>
</tbody>
</table>

Results from Alternative Data Sets and Interviews

Several alternative data sources were examined so as provide a more well-rounded and complete picture of the current situation in high school education in the state of Nuevo León. These sources include the 2002 Mexican Family Life Survey (ENNViH for its Spanish initials), 2000 Mexican Population and
Housing Census for Nuevo León (Censo de Población y Hogares), ENLACE 2007, The 2003 Programme for International Student Assessment (PISA) and interviews with public education officials in the state of Nuevo León, Mexico.

The ENNViH supported this paper’s model in conclusions that economic factors (employment status and family income) play a principal role in determining high school enrolment in Nuevo León. The 2000 Mexican Population and Housing Census for Nuevo León was reinforced by ENNViH in the responses of individual motivation for quitting school (see Figure 14). The three most frequently reasons reported in both surveys were: the individual finished school, the individual did not want to continue school, and the individual faced economic difficulties affecting their ability to attend school. These responses corroborate to a great degree the importance of income in the educational decision that we detected in our regression models. Perceptions of one official within the Secretary of Public Education office voiced agreement with economic factors being of considerable importance in school attendance decisions within the state of Nuevo León (Saucedo, 2007). The answer regarding motivations for school drop out of “did not want to or did not like attending” is vague and can not be easily captured by any single variable. The large percentage of respondents providing this answer can help us explain the probit model variation in school attendance not explained by our independent variables.

### Figure 14

**Survey Responses to the Question:**

What was the primary motivation why you quit school?\(^{15}\)

(Individuals older than 5 not attending school, 2000)

<table>
<thead>
<tr>
<th>Code</th>
<th>Motivation</th>
<th>Number of Responses</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Never attended school</td>
<td>1,602</td>
<td>2%</td>
</tr>
<tr>
<td>1</td>
<td>Did not want to or did not like attending</td>
<td>17,950</td>
<td>25%</td>
</tr>
<tr>
<td>2</td>
<td>Lack of money or had to work</td>
<td>23,584</td>
<td>34%</td>
</tr>
<tr>
<td>3</td>
<td>Married</td>
<td>5,304</td>
<td>8%</td>
</tr>
<tr>
<td>4</td>
<td>School too far away or there was no school</td>
<td>1,331</td>
<td>2%</td>
</tr>
<tr>
<td>5</td>
<td>Family prohibited attendance or had to help in the household</td>
<td>1,344</td>
<td>2%</td>
</tr>
<tr>
<td>6</td>
<td>School completed</td>
<td>18,258</td>
<td>26%</td>
</tr>
<tr>
<td>7</td>
<td>Other Motives</td>
<td>1,097</td>
<td>2%</td>
</tr>
</tbody>
</table>

Additional information obtained from both ENLACE 2007 and PISA 2003 indicated that Mexican students across the country are seriously ill-prepared for high school at the end of their final year of middle school. The ENLACE test is a standardised exam that measures math and Spanish aptitude at various levels throughout the school system. At the national level, the 2007 results reported that 94.4 per cent of students at the end of the final year of middle school possessed only basic or insufficient mathematics aptitude. In Nuevo León, the figure was 93.1. Though students performed better in Spanish exams, the

\(^{15}\)Source: Mexican Population and Housing Survey (Censo de Población y Hogares), 2000
percentage reaching only basic or insufficient levels was still a shocking 74.6 nationally, and 81.1 in Nuevo León (Secretary of Public Education, Mexico, 2007).

PISA is an initiative through the Organisation for Economic Cooperation and Development (OECD) to allow for cross-country comparisons of education for students 15 and 16 years old. In Mexico, the age corresponds to the last year of middle school and in some cases to the first year of high school. The 2003 study indicated that Mexican students at this level fell far short of nearly all other participating countries in aptitude levels in mathematics, reading and problem-solving (Programme for International Student Assessment, 2003). Mexican students ranked in the bottom four slots among participating countries in Europe, Asia and the Americas. This lack of academic preparation is anticipated to exacerbate drop-out incentives at the high school level.

Insight from representatives of the Secretary’s Office of Public Education in Nuevo León further complicates the situation. While elementary and middle school education in Mexico are centrally organised, regulated and standardised, high school education varies greatly from one school, city or region to another. In the country, Mexico has over 25 different systems of high school education. In Dr. Paniaua, the State Coordinator for High School Education’s, opinion, the lack of coordination and complexity of the supply of education at this level further discourages student success. Adolescents are required to select an educational path and usually an area of focus when they choose which high school to attend. This occurs at the age of 15, before many students are equipped to determine the career path they wish to follow.

VI. Theoretical Behaviour Model and Calibrations

Theoretical Model

There are several ways to model the high school enrolment decisions of adolescents. While we recognize that schooling provides a series of non-economic benefits, in this study we will consider only the monetary components. As such, the decision to attend school can be treated as an investment problem, as we discussed in the previous section (also see Becker, 1964). In order to solve for the optimal decision, the simplest approach is to follow a standard project evaluation framework. Under this logic attending high school would be economically wise if:

16 Participating countries included: Australia, Austria, Belgium, Brazil, Canada, China, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, Indonesia, Ireland, Italy, Japan, Korea, Latvia, Liechtenstein, Luxembourg, Netherlands, New Zealand, Poland, Portugal, Russia, Serbia, Slovak Republic, Sweden, Spain, Switzerland, Thailand, Tunisia, Turkey, United Kingdom, U.S.A., Uruguay
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ation framework. Under this logic attending high school would be economically
wise if:

\textsuperscript{16}Participating countries included: Australia, Austria, Belgium, Brazil, Canada, China,
Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland,
Indonesia, Ireland, Italy, Japan, Korea, Latvia, Liechtenstein, Luxembourg, Netherlands, New
Zealand, Poland, Portugal, Russia, Serbia, Slovak Republic, Sweden, Spain, Switzerland,
Thailand, Tunisia, Turkey, United Kingdom, U.S.A., Uruguay
\[
\sum_{t=td+1}^{T} \frac{hs}{(1+r)^t} > \sum_{t=1}^{T} \frac{ms}{(1+r)^t}
\] (5)

In this case \(T\) is the number of years worked in the employees’ lifetime\(^{17}\), \(td\) is high school duration, \(hs\) and \(ms\) are the annual salaries for workers with high school and middle school qualifications, respectively and \(r\) is a discount factor. While the project evaluation analysis is a sensible benchmark and has been widely used (Harberger, 1976; Rojas, Angulo and Velázquez, 2000), it obscures a number of factors that an individual can potentially face.

In order to explore the behavioral consequences for an individual investment under a household setting, we rely on the following simple model. Each household maximizes a strictly concave, continuous and negatively bounded utility function \(u(c)\). The household receives a constant flow of income \(I_t\), and it faces the decision of whether or not to send a child to high school. We assume the household behaves unitarily (so the child’s income would be pooled) and needs a minimum consumption in each period of \(c^0\), a level typically associated with survival, that is: \(u(c < c^0) = -\infty\). Expected salaries for different educational levels are certain and constant over time.\(^{18}\) The household maximization problem becomes:

\[
\max U_t(c_0, c_1, ..., c_T) = u(c_0) + \sum_{t=1}^{T} \beta^t u(c_t)
\] (6)

where \(\beta\) and \(\delta\) are two discount factors. When \(\beta = 1\), as we assume in this part, (7) becomes the familiar case of exponential discounting with time additive homothetic preferences. Assuming unrestricted lending and borrowing\(^{19}\) at a risk-free interest rate \(r\), two alternative budget constraints emerge:

\[
\sum_{t=1}^{T} \frac{c_t}{(1+r)^t} = \sum_{t=1}^{T} \frac{I + ms}{(1+r)^t} = PV I
\] (7)

if the child does not attend high school, or

---

\(^{17}\)Calculated as the expected retirement age minus the age at which a worker begins employment.

\(^{18}\)In this paper we are interested in the influence of discounting over educational decisions. Nonetheless, to investigate other factors affecting the decisions, both the unitary framework and salary certainty can be relaxed.

\(^{19}\)For finite \(T\) we assume the no Ponzy game restriction.
if she does.

Under the assumptions made, even without solving for the Euler equations, it is easy to see that the solution to (7) coincides with (6). The intuition is straightforward, individuals should obtain the maximum amount of resources possible and divide them through time according to their preferences. Thus, the decision to invest in studying high school is linked to the maximization of the present value of income $PVI$, $\partial U_i / \partial PVI > 0$ despite the relationship between $\delta$ and $\frac{1}{1+r}$. Under the simplest household framework, the maximization of the present value of income implies the household’s utility maximization. We will call this result the basic discounting equilibrium (BDE). We are interested in modeling high schoolers’ attendance decisions as accurately as possible. Here we explore three relaxations of the assumptions that may overcome BDE.

Credit Rationing

The results of the previous section assumed that households were capable of unlimited lending and borrowing at a risk-free interest rate, subject to their life earnings. However, it has been extensively concluded that poor households face important credit constraints (Stiglitz and Weiss, 1992; Ghosh, Mookherjee and Ray, 2000). For simplicity we will assume that households are able to lend (save) any desired amount, and receive the aforementioned risk-free interest rate $r$. On the other hand, they are not allowed to borrow. Now we investigate to what extent this decision is binding. The solution to (7) would yield a standard Euler equation:

$$
\sum_{t=1}^{T} \frac{c_t}{(1+r)^t} = \sum_{t=1}^{hd} \frac{I}{(1+r)^t} + \sum_{t=hd+1}^{T} \frac{I + hs}{(1+r)^t} = PVI
$$

such that $c_t > c^0$ for every $t$. Now, under additive preferences with strictly concave period utility functions, the conditions $\delta \geq \frac{1}{1+r}$ and non-decreasing income are sufficient to ensure that all income from each period is spent on consumption in the same period. Unavailable borrowing impedes that future resources are consumed before they are generated. Under this set of conditions (10) will not necessarily hold. Non-compliance with the Euler equation is a necessary but insufficient condition to invalidate BDE. However if all the period’s income is consumed, and:
\[
\sum_{t=1}^{T} \delta^t u(I + ms) > \sum_{t=1}^{hd} \delta^t u(I) + \sum_{t=hd+1}^{T} \delta^t u(I + hs) \tag{10}
\]

holds, then a household’s optimal choice may not coincide with the PVI maximization.

**Present Biased Discounting**

An important critique to traditional exponential discounting has originated both in the theoretical and empirical literatures (Laibson, 1996; 1997; Rabin 2007). When confronted with data, exponential discounting tends to predict bizarre parameters, (i.e. extremely low \(\delta^t\)’s). Laibson cites a series of studies that suggest individuals’ intertemporal preferences are not exponential, but rather they appear to be hyperbolic (1997). He proposes a "slight perturbation" of the canonical model. By introducing a second discount factor (the \(\beta^t\) in (7)) and assuming it to be less than 1, hyperbolic preferences can be emulated within the exponential framework while keeping the analytical tractability of the canonical model. Rabin argues that this augmented model predicts much more realistic parameters (2007).

In the problem studied in this paper, present biased discounting is important because it may exacerbate the results of the previous section.\(^{20}\) A modified version of (11) emerges:

\[
u(I + ms) + \beta \sum_{t=1}^{T} \delta^t u(I + ms) > u(I) + \beta \left( \sum_{t=1}^{hd} \delta^t u(I) + \sum_{t=hd+1}^{T} \delta^t u(I + hs) \right) \tag{11}
\]

The implication of (12) is that income "sacrifices" while attending school become more expensive compared with (11). Nonetheless (12) may not pose the most interesting question. The reason is that it implies what in the behavioral economics literature is called a "now or never question" (take it or leave it offer). In the context of our paper this would translate into the requirement that the decision to study a high school education has to be taken in period 0. Being more realistic, a rational household may choose to study high school but not to begin in period 0. This would be the case if:

\(^{20}\)The model presented here includes only consumption in the utility function. However if other arguments were included (e.g. leisure, effort, etc.), educational investment under present biased discounting can occur without credit rationing.
so even if (12) does not hold, the household may postpone the attendance decision one period. In period 1 the decision facing the household would be very similar to the problem in (13), only starting one period later. The present biased discounting can generate inconsistencies. The prediction of the final outcome depends largely on how we believe a household evaluates its future preferences. Rabin distinguishes between "sophisticated" decision rules, where the household understands its present bias and thus decides using (12), and a "naive" agent who believes her bias is temporary and can be perpetually trapped in (13) (2007). Assuming hyperbolic preferences, there is room for a wide spread of middle ground between the two types of rules. The ultimate true behavior would be an empirical question.

Endogenous Discounting

A third critique to BDE stems from Chavas (2004; 2005). He argues that, by construction, a specification like (7) implies two assumptions: first, preferences are additive and second, future discounting is done at an exogenous rate \( \delta \), assuming \( \beta = 0 \). Despite its convenience, the additive utility function (7) is not capable of capturing the essence of extreme poverty issues. Notice it implies \( \frac{\partial U_t}{\partial c_t} = 0 \) for all \( t \neq t_0 \). Thus the marginal utility of consumption is independent of consumption at other periods. Given that survival issues are involved in extreme poverty, current consumption must affect the marginal utility of future consumption.\(^{21}\)

A recursive specification of household preferences can be set as:

\[
U_t = V(c_t, c_{t+1}, \ldots, c_T) = U_t(c_t, V(c_{t+1}, \ldots, c_T))
\]

where \( U_t(c_t, V(c_{t+1}, \ldots, c_T)) \) is non-satiated in \( c_t \), and \( 0 \leq \frac{\partial U_t}{\partial V} < 1 \). Specification (14) is a generalization of (7). Since (14) allows \( \frac{\partial U_t}{\partial x_{t'}} \) to depend on \( x_t \) for \( t' > t \), it allows current consumption to affect the marginal utility of future consumption, thus permitting the capture of survival issues. The discount factor \( \frac{\partial U_t}{\partial V} \) will vary with economic conditions. For example if food and

\(^{21}\)At least for consumption of food, but consumption other necessities could also arguably also be considered to affect the marginal utility of future consumption (e.g. medicines).
other basic necessity consumption is very low and threatens survival, it will affect the way in which the household views the future. In this circumstance, a very low discount factor can be anticipated (i.e. $\partial U_t/\partial V \approx 0$). The intuition is that concerns for survival make poor households focus attention on short term decisions, sacrificing longer term payoffs. A direct test of this alternative specification is a check of whether present levels of household consumption affect the investment decisions.

**Calibrations**

Utilising the calculated monthly salaries from our economic returns to education regression results, we can run calibrations calculating the present value of total lifetime earnings for workers with a middle school or a high school education in Nuevo León. We calculate these figures for the equations (6), (7), (11), and (12). A real interest rate ($r$) of 0.05 is assumed, the discount rate ($\delta$) is set at 0.9, and the retirement age used is 65. In all three calibrations, the average annual salary for a worker with an elementary education is used as the exogenous income. We selected this income because given our probit model results, we suspect that adolescents from families in the lower socioeconomic bracket are more susceptible to high school drop out and we wanted to model our calibrations to this demographic group. To model the mathematical form of the utility curve, we used the natural logarithm of income ($\ln W$).

Utilising the standard present value and utility equations (6) and (7), calibrations for the present value of lifetime earnings fall cleanly in line with the results uncovered in the two empirical models presented in this paper: in the general case, the present value of lifetime earnings for a worker with a high school education exceeds that of a worker with middle school education.

When credit rationing is introduced (equation (11)), the restriction is sufficiently large to reverse the order of present value earnings and render high school attendance uneconomical, i.e. $U(ms) > U(hs)$. As we have seen, economic reasons are a primary motivator for high school drop out in Nuevo León. Our calibrations suggest that those households in lower socioeconomic groups without access to credit (or access only at exorbitant interest rates) find it economically justified to truncate the education of their adolescent members at the middle school level.
Figure 15

Present Value of Family Lifetime Earnings in Pesos and Utility:
Middle School Education vs. High School Education

<table>
<thead>
<tr>
<th></th>
<th>PV middle school</th>
<th>PV high school</th>
<th>Return for completing high school</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexican Pesos</td>
<td>$1,899,544</td>
<td>$2,001,326</td>
<td>$101,782</td>
</tr>
<tr>
<td>Utility Net Present Value</td>
<td>114.90</td>
<td>115.42</td>
<td>0.52</td>
</tr>
<tr>
<td>Utility Credit Rationing</td>
<td>114.45</td>
<td>113.27</td>
<td>-1.18</td>
</tr>
</tbody>
</table>

When calculating present value earnings in a situation of present biased discounting (equation (12)), we set the second discount factor, β, equal to 0.9 for consistency. This produces a first period total discount factor of 0.8.

Figure 16

Present Value of Family Lifetime Earnings in Pesos and Utility,
High School Education Now vs. One Period Later:
Present Biased Discounting

<table>
<thead>
<tr>
<th></th>
<th>PV high school, entrance t+1</th>
<th>PV high school</th>
<th>Return for completing high school if entrance delayed one period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexican Pesos</td>
<td>$1,995,078</td>
<td>$2,001,326</td>
<td>$6,248</td>
</tr>
<tr>
<td>Utility Present Biased Discounting</td>
<td>103.2</td>
<td>103.01</td>
<td>-0.19</td>
</tr>
</tbody>
</table>

In this situation we see that delaying the high school entrance decision by one period actually produces (slightly) higher utility. The problem here is that today is yesterday’s tomorrow, and the tendency to put off the entrance decision is potentially present in every period. However, as shown in Figure 2, Nuevo León youth were returning to high school after a period of absence in 2005-2006. This leads us to believe that the above presented case may be the reality for at least some families with adolescents in the state.

In the case of Endogenous Discounting, we can not produce concrete calculations utilizing regression results. However, we can examine the statistically correlated sociodemographic variables from the probit regression model to construe information regarding the presence of endogenous discounting in Nuevo León. Our probit results find that income is one of the most important factors in predicting high school attendance. This means that educational consumption may depend heavily on a family’s income at any point in time. In cases of poverty stricken households, fluctuations in family income from one period to another change the way in which members view the future. In cases of very low household income, the family will tend to focus available resources on current
consumption needs and desires; they may sacrifice longer run investments such as education for the consumption required for survival in the present.

**VII. FINAL RESULTS AND ANALYSIS**

**Summary of Results**

The reasons behind the high drop out rates and low school attendance at the high school level in the Mexican state of Nuevo León are many. The situation appears to be primarily driven by economic factors, including the labor market, lack of salary incentives for workers with high school education, high opportunity cost of time and need for income in the present period.

The results of our regressions estimating the economic returns to high school education are discouraging. Due to the construction of the returns to education model, the economic return to each year of education is cumulative (i.e. the sum of the coefficients for each year produces the total return multiplier). However, the negative estimator indicates that salaries for workers with years of high school education increased at a decreasing rate, as compared to workers with only middle school education. The lack of statistical significance occludes the conclusion that having attended high school has any effect on salary. It is not overly surprising then, that we find by far the most important factor affecting the probability that an adolescent attends high school to be their employment status. If young people are working, they are over 50 per cent less likely to attend school. We found family income to be the second most important factor in the decision to attend high school, which is reflected in economic related Population and Housing Census survey responses to the question “What was the primary motivation why you quit school?” The relevance of family income in the high school attendance decision is raised further when we consider potential credit rationing effects. In our calibrations, lack of access to credit can be a sufficiently large economic restriction to render high school attendance an uneconomical decision.

It is also important to note that while economic factors appear to be the primary factors in the high school attendance decision, there are also sociodemographic and social policy factors involved. Our participant characteristics model uncovered that being male increased an adolescent’s probability of attendance by 20 per cent and higher levels of education of the head of household was correlated with increased probability of attendance. In preliminary regressions, it was found that families who received support from the government program Oportunidades or other scholarships realized important increases in the probability of sending their adolescents to high school. This result remained statistically significant even measuring purely for remaining effects beyond the income and conditioning factors. Two additional findings increase the likeli-

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22 The probit model was initially run with Oportunidades and other scholarship variables. However, they were reconstructed due to the problems of endogeneity and conditionality mentioned in section V.
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tests administered by ENLACE 2007 and PISA 2003 demonstrate that overall,
Mexican youth in their last year of middle school and first year of high school
are severely under prepared to meet the requirements of their academic cur-
ricula. Second, according to observations by the State Coordinator for High
School Education from the Mexican Secretary’s Office of Public Education, low
skilled employment positions are readily available and relatively easy to obtain
in Nuevo León (Paniaua, 2007). Combined with insignificant economic returns
to high school and the probability that work interferes with academic obliga-
tions, these two factors only create further drop out incentives for adolescents.

In our calibrations for present bias discounting, we see that young people
may find it economically desirable to postpone high school entrance by one
or more periods. This is corroborated by entrance statistics published by the
Mexican Secretary’s Office for Public Education (see Figure 2). The concern
here is whether or not adolescents will actually enter high school in period $t+n$.
If we allow ourselves to consider that young people from lower socioeconomic
groups may have higher discount rates for time, i.e. are more impatient in
terms of foregoing current consumption to attend additional years of school, the
pressure to earn an income, ample availability of relatively well-paid low-skill
jobs and the apparent lack of economic return to the three additional years of
high school education can all be strong motivators to never reenter the formal
education system once they have completed middle school.

VIII. PUBLIC POLICY IMPLICATIONS

In light of the significant economic returns to middle school and university
education, the lack of return to high school is troubling. In the present situation,
the economic structure of the labor market provides no incentive to obtain an
high school education as a terminal level. We see this at both the national and
the state level, and further data previously included specifically for Nuevo León
corroborates this assertion.

Pursuing high school education makes economic sense only if a student plans
to continue on through university. While economic returns to education at the
high school level were not statistically significant, years of education at the uni-
versity and graduate level were highly positively correlated with income (years
of university increased returns by 8.5 per cent and years of graduate school by
33 per cent). Thus, there does exist significant incentive for students to continue
though high school if they believe they have the financial resources, intellect,
ability and desire to also attend college. 23 This attendance trend separates
workers into two vastly different groups: those with a middle school or lower
education and those with a university education or above. This division will

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23While there is near universal coverage of free public high schools in Nuevo León, both private and public universities have associated tuition and material costs and entrance requirements.
only widen the gap between poor and rich in Nuevo León, generating increased 
inequality in the medium term. It also lends support to our argument of the 
importance of critically examining particularly high school education in Mexico.

There are several government programs in Mexico aimed at increasing high 
school enrolment. The program Oportunidades provides academic scholarships, 
food subsidies and health care to individuals with economic need and their fam-
ilies. Receipt of support is conditional upon school enrolment. This program 
initially was available only to students up through middle school, and has been 
notably successful in increasing school attendance in lower education levels. In 
2003, the program was extended to include high school students as well. In 
Mexico City, the capital of Mexico, the local government initiated an additional 
scholarship program in 2005 to subsidize the costs of high school for students. 
Allocation of funds is determined by student qualifications and academic perfor-
ance (Ramirez and Quintero, 2005). These scholarship programs are un-
doubtedly beneficial in increasing school attendance in the immediate term. We 
have found that reducing the household costs of education (through scholar-
ships which increase household disposable income) is an important variable in 
increasing the probability that students continue their high school studies.24 
Funds they provide may be the key factor in the immediate attendance decision 
of adolescents in Nuevo León. However, the problem does not stop there; we 
find two larger concerns.

The next critical step is to understand why high school education does not 
carry a premium in the labor market. This issue is beyond the scope of the 
present study, but we present one conjecture that may merit further attention. 
Employers may not value years of immediate post middle school education due to 
the lack of standardisation in this level of schooling. With 25 different education 
systems at this level, all with varying grading systems and curricula, it is nearly 
impossible for an employer to determine the knowledge that any given worker 
may or may not have obtained in any given institution. Without a regulatory 
and accountability framework, the credibility associated with possession of a 
high school equivalent degree is severely diminished. It is probable that some 
high school systems or particular institutions have positive economic returns to 
education, while others have negative returns.

The lack of economic returns to high school education creates disincentives 
for students to participate in this level of schooling. In the long-run, if youth 
in Nuevo León do not perceive high school education to provide real salary 
benefits, they will continue to be highly prone to drop out. The disbelief in the 
idea that a strong academic record translates into success in the labor market 
is not rectified through scholarship programming. This is further the case when

24 Also, preliminary regressions confirmed that an adolescent’s receipt of Oportunidades or 
another scholarship were both highly statistically correlated with increasing the probability 
of attendance. In our Nuevo León sample, receipt of one or the other was a nearly perfect 
predictor of attendance.
young people see that they have access to employment positions in the current period, whereas they face uncertainty as to whether better opportunities will be available to them three years down the road when they possess a high school diploma. Thus, we face a structural issue (on one hand educational and on the other economic), not simply an income or access to education problem.

Raising average education levels is a topic of pivotal importance in Mexico’s development. The current political and economic climates in Nuevo León well position the government to take on this issue with potential to successfully push through policy changes. If the economy continued to invest primarily in manufacturing and assembly industries that require only low skill labor, the population would continue to obtain only middle school of education. The state of Nuevo León realizes that this plan is not sustainable, even in the medium run, and has already taken a role in promoting the expansion of high technology industry and attracting investment in emerging sectors. Two aspects of the current proposal to develop the state capital of Monterrey into an “International City of Knowledge” can be directly applied to the problem of high school enrolment in the state. These include the desire to attract investment in scientific, technology and innovation sectors and reform of the state educational agenda. Both of these areas provide prime opportunities to closely examine the current situation of post middle school education and propose restructuring that will strengthen its quality and economic remunerability.

In this paper, we explored and clarified why students are choosing not to attend high school in Nuevo León. The important questions now become why education at this level does not carry increased economic returns over middle school education and how the government can stimulate demand for workers who possess high school acquired skills. The government of Nuevo León should take the educational composition of the populace seriously, for it carries great implications for both the economic and social development of the state in the long-run. A hard look at the structural economic and systematic issues related to high school education in the state is of primary importance.

25The Inter-American Development Bank recently signaled that education is one of the five key issues Mexico must focus on to stimulate successful growth and development in the country (El Norte, 2007).
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